

AGGRESSIVE MIMICRY BY THE JUVENILE OF THE REDMOUTH GROUPER, *AETHALOPERCA ROGAA* (SERRANIDAE)

by

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ABSTRACT. The juvenile of the Redmouth Grouper, *Aethaloperca roga* (Forsskål, 1775), which is colored differently than the adult, closely resembles several small, non predatory reef fishes (*Centropyge* spp., *Pomacentrus* spp., and *Stegastes* spp.). We argue that this resemblance is not simple convergence or coincidence, but mimicry. The mimic and models have overlapping geographic ranges, the mimic and the models occupy the same habitat, and the mimic alters its normal behaviour to enhance imitation of the models. By resembling small reef fishes *A. roga* gains the advantage of disguise when foraging for small fishes, thus this is an example of aggressive mimicry.

RÉSUMÉ. Mimétisme d'agressivité chez le jeune *Aethaloperca roga* (Serranidae).

Les juvéniles du Serranidae *Aethaloperca roga* (Forsskål, 1775), dont la coloration diffère de celle de l'adulte, ressemblent étroitement à plusieurs petits poissons récifaux non prédateurs (*Centropyge* spp., *Pomacentrus* spp., et *Stegastes* spp.). Nous interprétons cette ressemblance non comme une simple convergence ou une coïncidence, mais comme du mimétisme. L'imitateur et ses modèles ont des distributions géographiques qui se chevauchent et le même habitat. De plus, l'imitateur modifie son comportement normal pour renforcer l'imitation des modèles. Grâce à cette ressemblance, *A. roga* a l'avantage de se camoufler quand il chasse des petits poissons, exemple typique d'un mimétisme d'agressivité.

Keywords. Serranidae - *Aethaloperca roga* - ISW - ISEW - Behavior - Mimicry.

Groupers (subfamily Epinephelinae) are important predators in coral reef and hard bottom habitats worldwide (Heemstra and Randall, 1993). Field observations of grouper feeding behaviour indicate that several species employ special stalking behaviours when approaching prey. These behaviours include riding (hiding) behind, or intermingling with, harmless species to conceal the grouper's presence (Montgomery, 1975; Ormand, 1980; Shpigel and Fishelson, 1989), following foraging species (usually moray eels or octopus) to intercept prey flushed from hiding places in the reef by the forager (Montgomery, 1975; Karplus, 1978; Dubin, 1982; Diamant and Shpigel, 1985; Strand, 1988; Shpigel and Fishelson, 1989), and aggressively mimicking non-predatory species (Montgomery, 1975; Randall and Kuitert, 1989; Kuitert, 1995; Snyder 1999).

In several grouper species, adult and juvenile colour patterns differ considerably (Heemstra and Randall, 1993). Although the function of this ontogenetic colour change has been little studied in most species exhibiting the trait, the distinctively coloured juveniles of three grouper species were found to be aggressive mimics (Randall and Kuitert, 1989; Kuitert, 1995; Snyder, 1999). For reef fishes in general, adaptive explanations of ontogenetic colour change include intraspecific aggression, crypsis, aposematism, and mimicry (Booth, 1990;

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Thresher, 1984; Fricke, 1980). The juvenile of the Redmouth Grouper *Aethaloperca rogaa* exhibits a colour pattern that is different from the adult; however, the function of this colour pattern is not known. Here we argue that the adaptive significance of the juvenile coloration in *A. rogaa* is mimicry.

OBSERVATIONS AND DISCUSSION

Aethaloperca rogaa is dark brown and very deep-bodied for a grouper (Fig. 1). As a juvenile it superficially resembles small non-predatory dark brown reef fishes of the same general shape. When it is a small juvenile (□ 60 mm TL; Fig. 2), it most resembles the small dark angelfishes *Centropyge flavicauda* Fraser-Brunner, 1933 (Fig. 3), *C. multispinis* (Playfair & Günther, 1867) (Fig. 4), and *C. flavipectoralis* Randall & Klauswitz, 1977 (Fig. 5). Other colour features which increase its resemblance to the angelfishes include the bright blue leading edge of the pelvic fins, and a blue margin on the soft portion of the dorsal and anal fins. The posterior part of the caudal fin is translucent white and broader dorsally and ventrally, thus giving the impression of a short rounded caudal fin. The pectoral fins may be yellow. The head and breast may have an orangish cast. All of these colour features are lost in the adult.

When it is a larger juvenile (60 to 140 mm TL) (Fig. 6), it is most similar to adults of several Indo-Pacific species of damselfishes of the genera *Stegastes* and *Pomacentrus*. Some such as *Stegastes obreptus* (Whitley, 1948) (Fig. 7) of the western Pacific and eastern Indian Ocean and *S. nigricans* (Lacepède, 1802) (Fig. 8), wide-ranging in the Indo-Pacific, may have a blue margin on the pelvic, dorsal, and anal fins. Also of significance is the change in the color of the caudal fin in *A. rogaa* with growth. The translucent whitish outer part is now broader centrally, and the dark basal part is slightly forked like the caudal fin of these damselfishes, in contrast to the rounded fin of the species of *Centropyge*.

Aethaloperca rogaa ranges from the Red Sea and coast of East Africa to Fiji; in the western Pacific from southern Japan to the Great Barrier Reef. There are dark damselfishes throughout its range and at least one of the species of dark *Centropyge* is always present. *C. flavicauda* is distributed from French Polynesia to the Maldives; *C. flavipectoralis* appears to be restricted to Sri Lanka and the Maldives; *C. multispinis* occurs in the Red Sea and throughout most of the tropical and subtropical Indian Ocean.

The resemblance of *A. rogaa* to the various species of small reef fishes mentioned above was not believed to have any special significance until an observation was made by the senior author while diving at North Malé Atoll in the Maldives. A juvenile of *A. rogaa*, about 100 mm TL and coloured similarly to the individual in figure 6, was behaving in a manner not characteristic of groupers. It was swimming with its pectoral fins during short periods of 10 to 30 seconds over the course of one hour. Pectoral fin sculling is the normal swimming mode of several families of reef fishes (but when more speed is needed, the caudal fin is brought into action) such as damselfishes, wrasses, parrotfishes, and angelfishes of the genus *Centropyge*. This is not the manner in which groupers swim (groupers normally use the caudal fin as the primary source of propulsion). The juvenile *A. rogaa*, while swimming with its pectorals, made several attempts to seize individuals of the damselfish *Chromis viridis* (Cuvier, 1830) from a school hovering above an *Acropora* thicket at the edge of the reef slope where the water depth was 8 m. Although these feeding attempts were unsuccessful, the *C. viridis* did not exhibit any fright reaction until the grouper approached within a few centimeters from the school. This observation led our conclusion that *A. rogaa* is an aggressive mimic. When a mimicking species alters its normal behaviour to imitate the model, the argument for mimicry

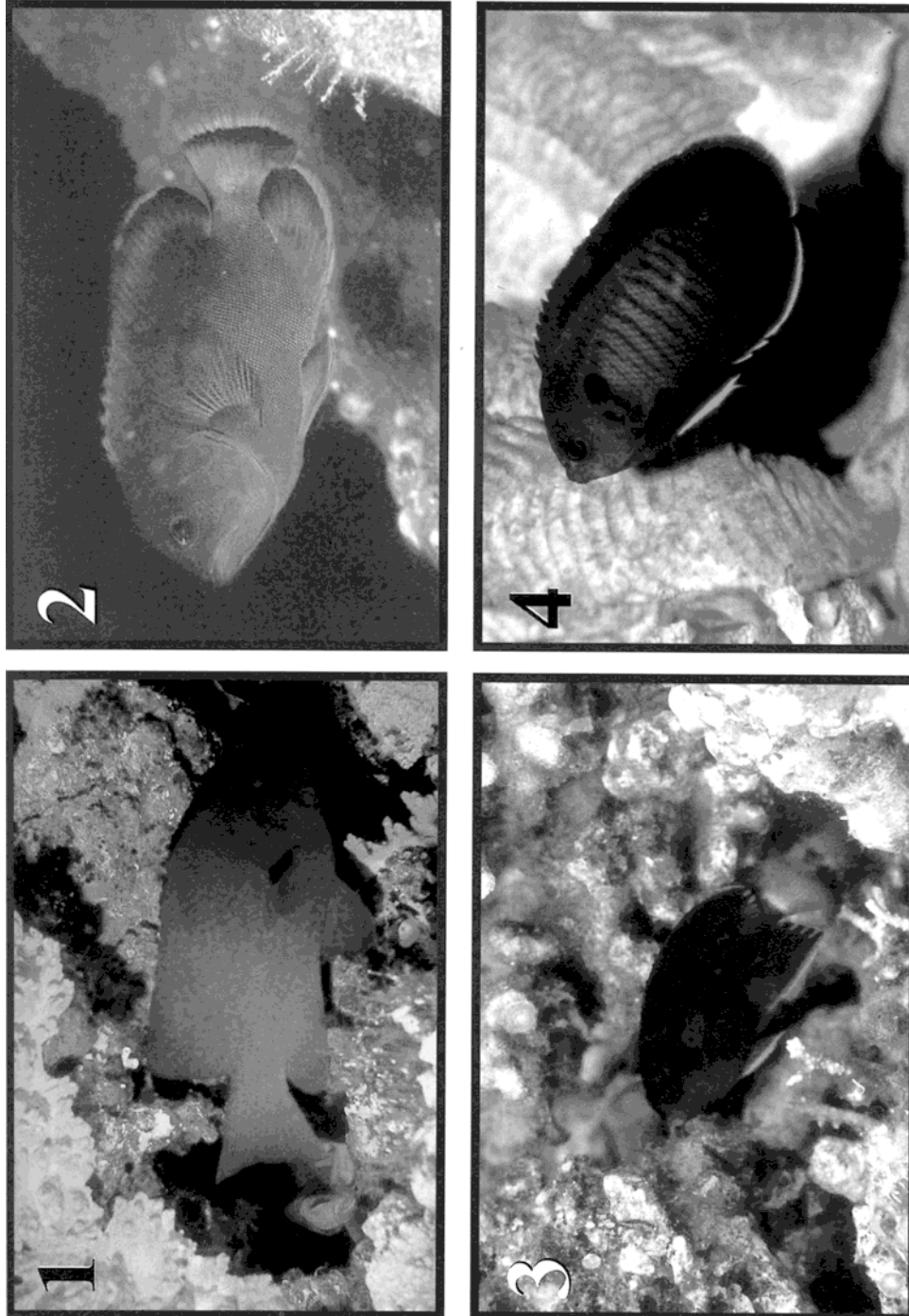


Fig. 1. Redmouth Grouper *Aethaloperca rogaa* (Adult ca 350mm TL). (Photo J.E. Randall). Fig. 2. Redmouth Grouper *Aethaloperca rogaa*, 60mm TL. (Photo J.E. Randall). Fig. 3. Entropyge *entropyge multispinus*, 90mm TL. (Photo J.E. Randall). Fig. 4. Entropyge *entropyge multispinus*, 90mm TL. (Photo S.W. Michael).

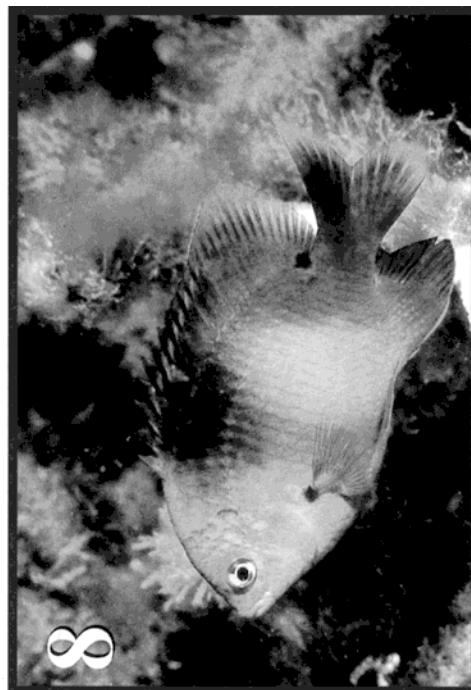
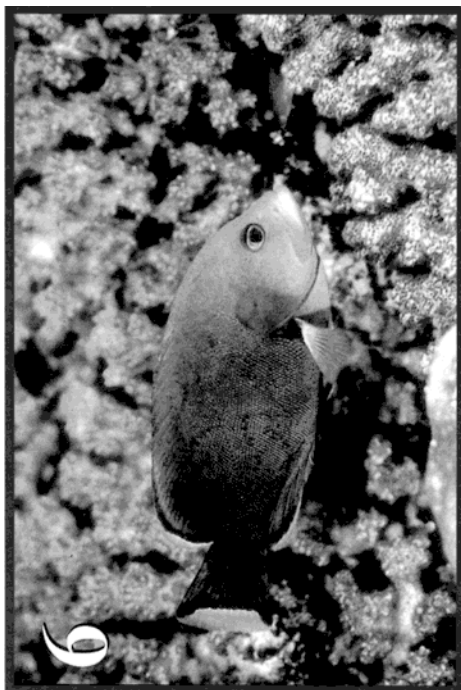


Fig. 5. *Entropogae flavipectoralis*. (Photo S.W. Michael). Fig. 6. *Aethaloperca rogaa*, 130 mm TL. (Photo J.E. Randall). Fig. 7. *Egastes obrepus*. (Photo J.E. Randall). Fig. 8. *Egastes nigricans*, 140 mm TL. (Photo J.E. Randall).

is strengthened (Randall and Randall, 1960). For *A. rogaa* normal behaviour is hovering above the substrate, usually under a ledge or in a cave. This is not the first time a juvenile grouper has been observed imitating the pectoral fin swimming mode of a non-predatory species.

Juveniles of the Tiger Grouper, *Mycteroperca tigris* (Valenciennes, 1833), mimic the color pattern and swimming behaviour of the Bluehead Wrasse, *Thalassoma bifasciatum* (Bloch, 1791) in the western Atlantic (Snyder, 1999), and juveniles of the Blacksaddled Coral Grouper, *Plectropomus laevis* (Lacepède, 1801), imitate the pectoral sculling swimming style of the puffer *Canthigaster valentini* (Bleeker, 1853) (Randall and Hoese, 1986).

Damselfishes of various genera and angelfishes of the genus *Centropyge* have been reported as models in mimetic relationships with other reef fishes. For example, Randall and Randall (1960) and Thresher (1978) suggested that the Blue Hamlet, *Hypoplectrus gemma* (Goode & Bean, 1882) is an aggressive mimic of the Blue Chromis *Chromis cyanea* (Poey, 1860). Randall and Heemstra (1991) suggested that juveniles of the grouper *Epinephelus multinotatus* (Peters, 1876) may mimic the damselfish *Neopomacentrus sindensis* (Day, 1873). Moyer (1977) and Russell *et al.* (1976) described aggressive mimicry of several damselfishes of the genus *Chromis* by juveniles of the snapper *Lutjanus bohar* (Forsskål, 1775). The angelfish *Centropyge flavissimus* (Cuvier, 1831) has been reported as a model for the surgeonfish *Acanthurus pyroferus* Kittlitz, 1834, though the basis for mimicry in this case is not clear (Randall and Randall, 1960).

In summary, the juvenile of *A. rogaa* superficially resembles several small non-predatory species (*Pomacentrus* spp., *Stegastes* spp. and *Centropyge* spp.). This general resemblance, particularly the dark background coloration, could be explained as coincidence or simple convergence. Convergent evolution of unrelated species inhabiting a similar local environment is a likely explanation for the similarity in color pattern among the mimic and the models, but convergence would not necessarily exclude mimicry as an explanation (Vitt, 1992). Our analysis and observation of foraging behaviour indicate that this resemblance is not coincidental, but that the juvenile grouper gains the advantage of disguise while foraging for small reef fishes. We acknowledge that a single behavioural observation is tenuous, but we also know that simply observing juvenile *A. rogaa* in the field is rare due to their secretive habits. When this observation is coupled with other criteria used to establish mimicry (e.g., Randall and Randall, 1960), the hypothesis of mimicry by juvenile *A. rogaa* is supported. The mimic and the models occupy similar habitats within overlapping geographical ranges, the mimic alters its normal behaviour to enhance resemblance of the models, the mimic loses its juvenile coloration at about the size of the largest model (about 140 mm TL), and the mimic gains an advantage while foraging.

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